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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/781,920 | 02/20/2004 | Odo Wunnicke | INF-138 | 5298 |
| 48154 7590 04/13/2007 SLATER & MATSIL LLP 17950 PRESTON ROAD SUITE 1000 DALLAS, TX 75252 | | | EXAMINER RAYMOND, BRITTANY L | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 1756 | |
| SHORTENED STATUTORY PERIOD OF RESPONSE | | MAIL DATE | DELIVERY MODE | |
| 3 MONTHS | | 04/13/2007 | PAPER | |

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/781,920

Applicant(s)

WUNNICKE ET AL.

Examiner

Brittany Raymond

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 January 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 and 9-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 and 9-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.
The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
 2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
2. Claims 1-5, 9, 10, and 13-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hyon (U.S. Patent Publication 2004/0072108) in view of Torek (U.S. Patent 6599683 and Liu (U.S. Patent 6114099).

Hyon discloses a method of forming a resist pattern on a semiconductor device, comprising the steps of: coating a photoresist onto a wafer, which could be assumed to be a single layer as described in Claim 9 of the application, exposing the wafer, developing the exposed photoresist with developer so that a pattern is formed, cleaning the wafer with deionized water which contains a fluorocarbon surfactant to prevent pattern collapse, as stated in the abstract, and evaporating the liquid off of the wafer (Claim 2). This method is very similar to the process described in Claims 1 and 16 of

the application. It is also noted that the wafer is exposed using a 365 nm, 248 nm, 193 nm, or 157 nm light source (Claim 2), which is within the range of the exposure recited in Claim 13 of the application. Hyon also discloses that the rinsing step could have two sub steps. The first includes washing the wafer with deionized water to remove the developer, as stated in Claims 2, 17 and 20 of the current application, and the second includes rinsing the wafer with a mixture of the fluorocarbon surfactant dissolved in the deionized water (Paragraph 0029). The two-step rinsing process is similar to the process disclosed in Claims 4 and 19 of the application. Finally, Hyon discusses that a previous invention aimed to control resist pattern collapse by using a vibrator to make the contact angle 90 degrees (Paragraph 0008). This is the same as what is recited in Claim 14 of the application.

Hyon fails to disclose the step of applying a cationic surfactant to the wafer, which occurs during the rinsing process and that the cationic surfactant is dodecyltrimethylammonium bromide or tetradecyltrimethylammonium bromide. Hyon also fails to disclose that the rinsing solution containing the cationic surfactant is left on the resist for 10 to 120 seconds, the photoresist is a positive photoresist, the concentration of the cationic surfactant is the cause of the 90 degree contact angle, the concentration of the cationic surfactant in the rinsing medium is less than the critical micelle concentration, and that the cationic surfactant is present in both rinsing steps.

Liu discloses a technique for protecting patterned multilayer films comprising the use of dodecyltrimethylammonium bromide to block the further growth of the second set

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of layers on the sites of the first set of layers where the second set is placed (Column 8, Lines 30-44), as recited in claims 1 and 16 of the present invention.

Torek discloses a method for patterning a photoresist comprising: applying a photoresist to a substrate, selectively exposing the photoresist to actinic radiation, developing the photoresist with a developer that includes a surfactant to prevent pattern collapse as stated in the abstract, and which can be cationic, as stated in line 52 of column 3 of the detailed description, rinsing the photoresist pattern, and drying the photoresist pattern (Claim 45), all of which are similar to what is stated in Claim 1 of the current application. Torek also discloses that the developer is left on for one second to five minutes (Column 5, Line 30) which includes the range of time recited in Claim 5 of the application, the photoresist is a positive photoresist (Column 4, Line 29) as stated in Claim 10 of the application, and the concentration of the surfactant is less than the critical micelle concentration (Column 3, Line 45) as stated in Claim 15 of the application.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of forming a resist pattern on a semiconductor suggested by Hyon by using a cationic surfactant, as suggested by Torek, in the 2nd rinsing sub step because a cationic surfactant can have the same effect of preventing pattern collapse as the fluorocarbon surfactants listed in the Hyon application. It would have also been obvious to include the cationic surfactant, suggested by Torek, in both rinsing sub steps because this would give the cationic surfactant more exposure time to the patterned resist film to further help prevent pattern

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collapse. Leaving the cationic surfactant solution on for 10 seconds to 2 minutes, as similarly suggested by Torek, would have been obvious because it gives the solution more time to thoroughly absorb into the resist pattern. Along with this, it would have been obvious to use a cationic surfactant with a concentration less than the critical micelle concentration, as suggested by Torek, because Torek teaches that concentrations of these that are less than the critical micelle concentration will help the surfactants do their job of preventing pattern collapse more efficiently. It would have been obvious to have used a positive photoresist, as suggested by Torek, because it is stated that a positive or negative photoresist can be used with the solution that is being applied (Column 4, Line 27), which contains the same cationic surfactant as suggested in the application. Finally, it would have been obvious to have used dodecyltrimethylammonium bromide (DTAB) as the cationic surfactant, as suggested by Liu, in the processes of Hyon and Torek, because Liu teaches that DTAB is used to prevent photoresists from sticking to one another, which is similar to the process of forcing pattern structures of a photoresist apart in order to prevent pattern collapse.

3. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hyon (U.S. Patent Publication 2004/0072108) in view of Torek (U.S. Patent 6599683 and Liu (U.S. Patent 6114099) as applied to claims 1-5, 9, 10, and 13-20 above, and further in view of Simons (U.S. Patent 6656666).

The teachings of Hyon, Torek, and Liu have been discussed in paragraph 2 above.

Hyon, Torek, and Liu fail to disclose that the photoresist used is a chemically amplified photoresist.

Simons discloses a method of stabilizing a developed resist image comprising: providing a wafer, applying photoresist to the wafer, and imaging the photoresist (Claim 2), as well as developing the resist image, rinsing the resist image with rinse fluid, and critical point drying the fluid from the resist (Claim 1). Simons also discusses that in prior art, chemically amplified resists are used in the process of forming resist images (Column 1, Line 41).

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of patterning a photoresist on a semiconductor device by Hyon, Torek, and Liu by using a chemically amplified photoresist as suggested by Simons because chemically amplified resists are used when exposed to light with 248, 193, or 157 nm wavelengths (Column 1, Line 67), which is in the range of wavelengths suggested by Claim 13 of the application.

4. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hyon (U.S. Patent Application 2004/0072108) in view of Torek (U.S. Patent 6599683) and Liu (U.S. Patent 6114099) as applied to claims 1-5, 9, 10, and 13-20 above, and further in view of Messick (U.S. Patent 6451510).

The teachings of Hyon, Torek, and Liu have been discussed in paragraph 3 above.

Hyon, Torek, and Liu fail to disclose that the structure elements of the resist mask have an aspect ratio of greater than 3.

Messick discloses a method for developing a photoresist pattern on an electronic component substrate comprising: coating a photoresist film on an electronic component substrate, exposing the photoresist film, developing the photoresist film with a developer composition to form a photoresist pattern, rinsing the developed substrate with a rinse water solution containing an anionic surfactant, and drying the developed substrate (Claim 1). Messick also discloses that the semiconductor wafers having small feature sizes are characterized by high aspect ratios greater than about 3 (Column 4, Line 15), as suggested in Claim 12 of the application.

It would have been obvious to one of ordinary skill in this art, at the time of invention by applicant, to have modified the process of patterning a photoresist on a semiconductor device by Hyon, Torek, and Liu by making sure that the semiconductor wafers having small features sizes are characterized by aspect ratios greater than 3, as suggested by Messick, because semiconductors having an aspect ratio greater than 3 have a high chance of pattern collapse, and this is what the invention is trying to prevent.

Response to Arguments

5. In the response filed 1/29/2007, Applicant argues that the types of cationic surfactants used, which were added to claims 1 and 16, have not been described in Hyon, Torek, Simons or Messick. Examiner has included the reference, Liu, which discusses one of the claimed cationic surfactants. Liu is also used in the rejection of claims 2-5, 9-15, and 17-20 since they depend on claims 1 and 16.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

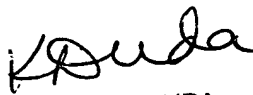
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brittany Raymond whose telephone number is 571-272-6545. The examiner can normally be reached on Monday through Friday, 8:00 a.m. - 4:30 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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KATHLEEN DUDA
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